166 145

1042-3699/94 $0.00 + .20

RESULTS AFTER LE FORT I OSTEOTOMY IN COMBINATION WITH TITANIUM IMPLANTS: SINUS INLAY METHOD

Michael C. Locher, MD, DDS, and Hermann F. Sailer, MD, DDS

A new procedure consisting of Le Fort I osteotomy, sinus and nasal floor bone inlays with simultaneous placement of titanium screw implants, and a modified submucous vestibuloplasty was first performed by Sailer in September 1987, and a report on the surgery was later published.[6, 7] This article describes the technique in detail as well as the results of all the cases performed by one surgeon.

MATERIALS AND METHOD

Indications

This method is indicated in all totally edentulous maxillae, especially those in which the intermaxillary relationship is disturbed. The method is even possible in partial edentulous maxillae when the intermaxillary relation should be also corrected. It is easier to use this method in maxillae with a residual alveolar bone, but the method works as well in totally atrophic maxillae. The implants can be placed simultaneously, as is usually done in the Department of Maxillofacial Surgery, University Hospital Zurich, but a delayed placement also is possible.

Operative Procedure

The mucosal incision is made on the alveolar ridge, with an additional median vertical cut and lateral vertical cuts in the region of the first or second molar. The periosteum is then stripped off carefully, and the Le Fort I osteotomies are performed. After down-fracture, the maxilla is mobilized until the correct intermaxillary relationship is reached. The mucous membrane of the maxillary sinus floor is then carefully removed (Fig. 1) with a rasp or a Freer instrument. It is necessary to use a bur to remove all the soft tissue (Fig. 2), especially if there is chronic sinusitis. The crest of the medial walls of the maxillary sinus can be removed by grinding with burs, because exact fitting of a bone transplant between the anterior, lateral, and medial walls of the maxillary sinus is very time consuming, especially in small sinuses.

An imprint of the surface of the sinus floor and the lateral and, eventually, the medial walls of the sinus is made (Fig. 3), using Kerr Impression Compound Type I Gray (Kerr USA, Romulus, MI). This material is heated until it becomes soft, and then the imprint is made (Fig. 4). Immediately afterward, the material is cooled by rinsing with 0.9% NaCl so-

From the Department of Maxillofacial Surgery, Zurich Medical School, Zurich, Switzerland

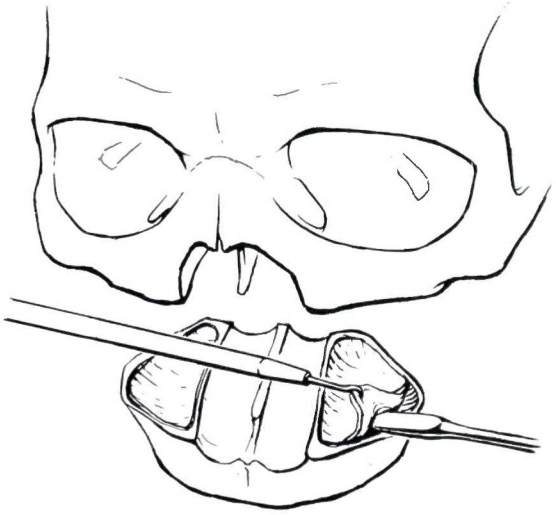


Figure 1. The periosteum is stripped from the floor of the maxillary sinus with a sharp rasp.

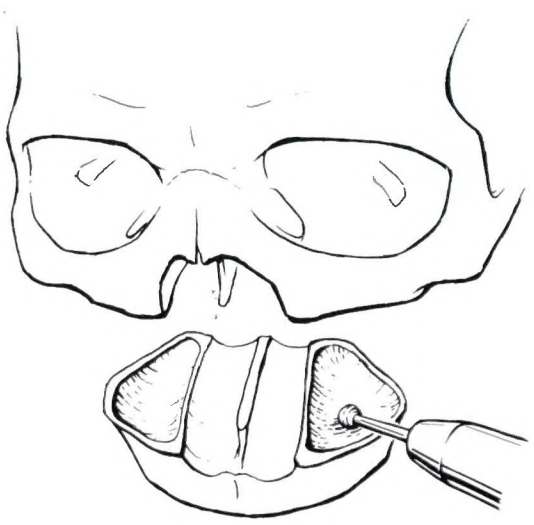


Figure 2. Remaining soft tissue is removed from the floor of the maxillary sinus with a bur.

lution. Then, another imprint is made with the same material, resulting in a model of the sinus floor (Fig. 5). It is important to press the material for the second impression as fast as possible to the cold first model, or the first model could warm and become deformed. Again, the second impression is rinsed with a cold solution and separated from the model. It is also possible to separate the material with a thin layer of petroleum jelly.

The autologous bone blocks are fitted on this positive cast. In our department, three pieces of autologous iliac bone are usually used. The bone can even be transplanted in a horseshoe shape (Fig. 6), making it much more difficult to adapt to the maxilla and nasal floor, but when it works, the stabilization of the bone transplant during insertion of the implants is easier. After fitting the bone transplant to the sinus floor, it is fixed by special bone clamps (Leibinger, Germany). Sometimes, the iliac crest bone is very thin, in which case it is possible to transplant two layers of bicortical bone. If the transplant is

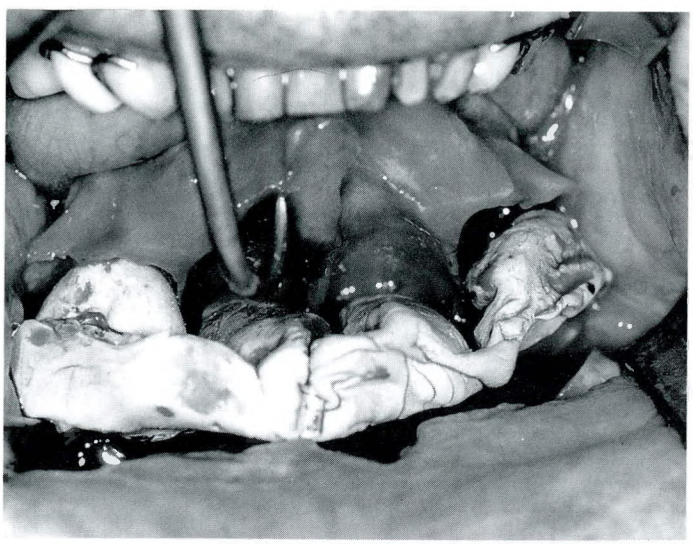


Figure 3. An imprint is made of the bony surface of the down-fractured maxilla. The imprint here is partially removed to allow visualization of the the maxillary floor.

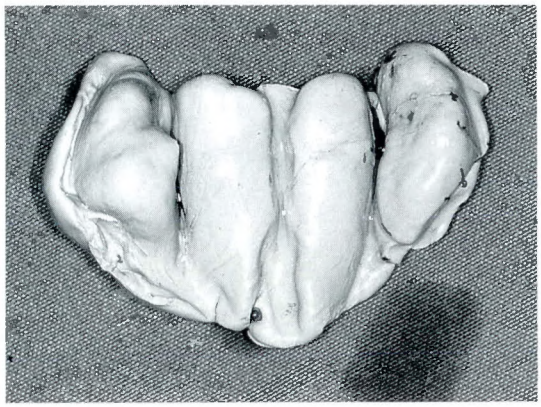


Figure 4. The negative imprint of the maxilla and nasal floor.

thick enough, we usually orient it as a bicortical transplant so that the implant perforates both cortical layers of the transplant (Fig. 7).

If the transplant is not thick enough for placement of a long implant but is more than 7 mm thick, it can be oriented vertically so that the implant is placed between the inner and the outer cortical plates in the spongiosa.

It is important to strip off the palatal mucoperiosteum only where the implants are to be placed. Any sharp residual alveolar crests are removed at the implantation site with a bur to obtain a plateau. Titanium screw implants are then inserted and stabilize the transplanted autologous bone blocks to the original maxillary bone. During placement of the implants, it should be considered that the angle between the axis of the mandibular incisors and the implants in the upper jaw changes by lowering the maxilla in the anterior part. A correct angulation of the implants in the original position of the maxilla (Fig. 8*A*) can change into a backward-tilted position after lowering of the anterior part of the up-



Figure 5. The positive model from which the bone blocks can be adapted to the exterior of the mouth.



Figure 6. A horseshoe shaped autologous bone graft can be used if there is a flat relief of the maxilla and nasal floor or if there are alveolar bone defects in the maxillary sinus, preventing the possibility of fixing separate bone grafts sufficiently.

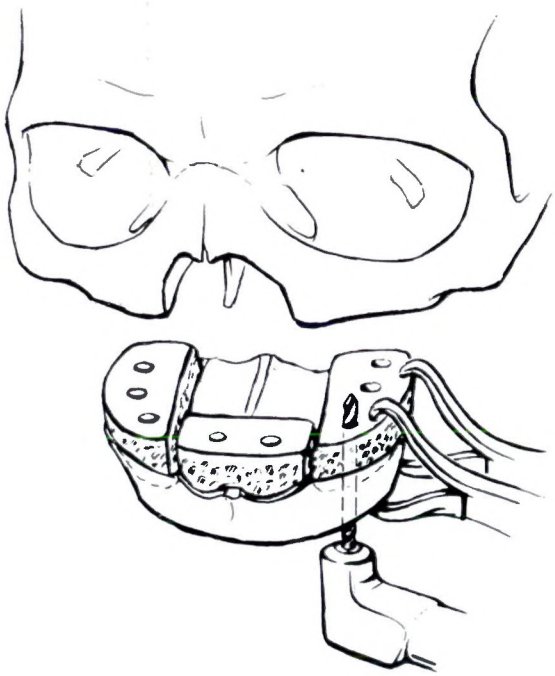


Figure 7. When drilling, it is important to perforate both cortical layers of the bone graft.

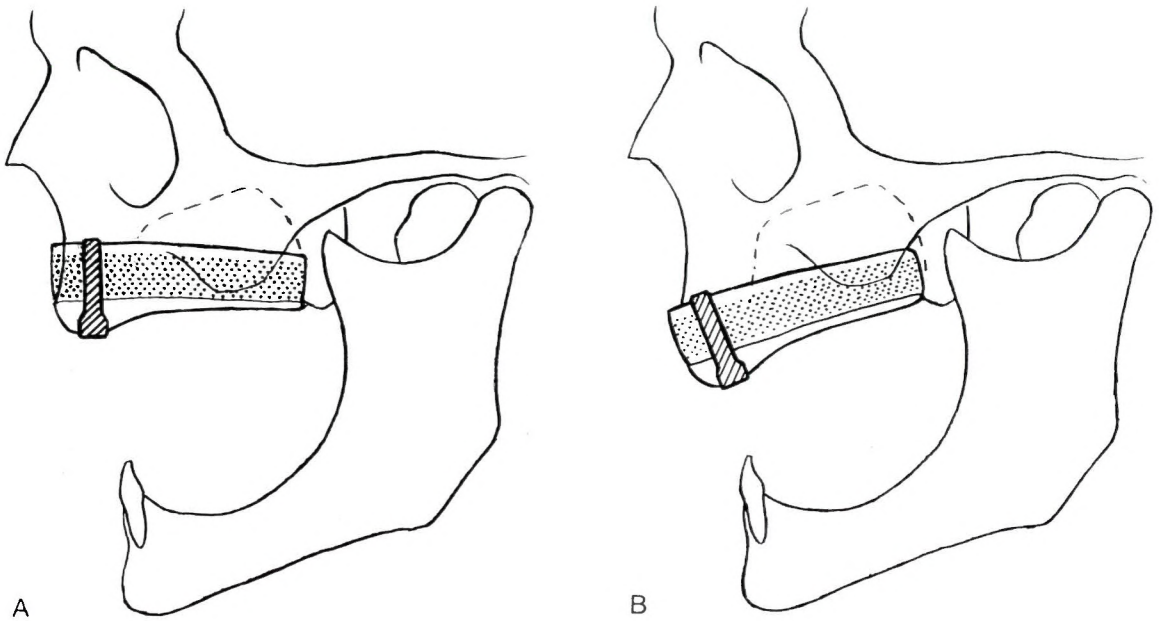


Figure 8. The direction of the fixtures should take into consideration the changed angle between the axis of the mandibular incisors and the fixtures after lowering of the maxilla in the anterior part. A correct angulation of the fixtures in the original position of the maxilla *(A)* can change into a backward-inclined position after lowering of the anterior part of the upper jaw *(B)*.

per jaw (Fig. 8*B*). Furthermore, because of the limited space the drill instruments are sometimes placed behind the lower anterior teeth and an unfavorable backward-inclined implant position results.

The maxilla is then positioned in the correct intermaxillary relationship and stabilized with miniplates, microplates, screws, wires, or a combination thereof. The last step is a modified submucous vestibuloplasty.

If there is a mandibular dentition, it is often necessary to cover the teeth of the lower jaw with a soft acrylic splint at the end of the operation to avoid damage to the soft tissues of the maxilla when the mouth closes.

Blood Supply and Bone Quality

It is very important to operate carefully, avoiding stripping off too much of the palatal mucoperiosteum, which could lead to bone necrosis. If the blood supply is doubtful, it is better to postpone placement of implants than to lose parts of the bone. Therefore, it is important to observe the color of the mucosa and bleeding from the bone during surgery, especially when the surgeon is less experienced. If no bleeding from the bone is visible after mobilization of the maxilla and removal of the mucosal lining of the floor of the maxillary sinus, it is advisable to return the jaw to its original position and wait until bleeding occurs, as is done in routine Le Fort I operations in dentate patients. When no bleeding occurs, the blood pressure should be raised. If this does not lead to bleeding from the osteotomied jaw, the bone blocks are fixed to the maxillary sinus by wires and the maxilla is brought to its original position without placement of implants. It is not advised that the surgeon guarantee the prosthodontist that the implants can be placed exactly in a predetermined position, because occasionally in heavily atrophic maxillae the original bone is missing or presents in very poor quality.

Postoperative Treatment

The patient receives antibiotics for 10 days. Two weeks after operation, the sutures are removed and an imprint is made. Temporary dentures are then manufactured and inserted.

The uncovering of the implants is possible 6 to 9 months after operation. Depending on the osseointegration, number, and length of the implants, the decision between a fixed bridgework or removable dentures supported by a bar is made.

RESULTS

Patients

Thirty-eight patients have been operated on by this method in our department. To evaluate a more homogeneous group of patients, the results achieved in 12 patients by only one surgeon are presented herein. Eight of these patients were female; 4, male. The youngest patient was 41 and the oldest 66 years of age, with an average age of 54 years.

Preoperative Situation

Eight of the 12 patients had an anterior or circular dentition of the mandible. Five patients had previously undergone one or more operations in the upper jaw. One patient had had an augmentation using a rib graft 14 years previously and a Le Fort I osteotomy 6 years beforehand. In 2 patients, implants were inserted in another clinic in a previous operation; 1 of these 2 patients presented after removal of a subperiosteal implant that had destroyed all the alveolar bone. In this patient, there was some residual hydroxyapatite from former trials to save the subperiosteal implant. In the other patient, a loose Linkow blade implant had perforated into the maxillary sinus. One of the remaining 2 patients had received a rib augmentation of the anterior part of the maxilla and a reduction of the tuber on both sides 17 years beforehand, and the other had undergone an excision of fibrous tissue of the upper jaw 11 years previously.

Operative Details

Between 6 and 9 Brånemark implants (average 7.25) were inserted into the maxilla, for a total of 87. Sixty-six of these implants were inserted after pretapping, and 21 were self-tapping implants. Twenty-nine implants were used in combination with bone morphogenetic proteins (BMP), 8 of them after pretapping; 21 were self-tapping implants. Thirty-four implants were placed in the front region, and 53 implants were placed in the premolar and molar region. Implants with a length of 10 to 20 mm were used, with an average length of 15.2 mm (3 × 10 mm, 17 × 13 mm, 46 × 15 mm, 19 × 18 mm, 2 × 20 mm). The fixation of the maxilla was performed with two or three miniplates in 6 patients, with four microplates in 1 patient, and with one microplate and one miniplate in 1 patient. Twice, a combination of miniplates paranasal and wires at the zygomatic buttress was used: once with a miniplate and seven screws, and another time with two microplates, two wires, and two screws.

Intraoperative Complications

In the patient with the anterior rib augmentation 17 years beforehand, a fracture of the maxilla in the region of the first molar occurred, and the bone in the region of the first and second premolar was so thin that it broke during the burring. The implants were kept only in the transplant. In this patient, we used self-tapping implants in combination with BMP. It was astonishing that all nine implants were firm when they were uncovered 10 months after operation.

In the patient in whom Linkow implants had been removed 6 months beforehand, a bone defect in the region of the second premolar and the first molar could be observed. In this case, a single U-shaped bone transplant was used and fixed with 6 self-tapping implants in combination with BMP. All the implants were firm when uncovered 7 months later.

In one patient a fracture of the tuber maxillae occurred during mobilization, without any consequence on the final outcome. In another patient, the pretapping of one implant had to be performed twice. The implant in this patient nevertheless became osseointegrated.

Postoperative Course

In the postoperative course in three patients after 3 to 7 months, one or two implants were

exposed. In one patient, a bilateral hypesthesia of the second branch of the trigeminal nerve could be observed for 3 months. One patient presented with a peri-implantitis in the region of the medial incisor 8 months postoperatively and showed a recurrent gingivitis until the last visit 2 years and 8 months postoperatively. On radiographs the implant does not seem to be osseointegrated in the apical and coronal parts, although it was clinically firm.

After an average observation period of 2 years, 8 months (ranging from 1 year to 5 years, 6 months), 83 implants (95.4%) still were in place; 3 were lost, and 1 was surgically removed 18 months postoperatively because this implant was not used for the bridgework. In this case the implant was firm and osseointegrated intraoperatively.

The three losses of implants occurred in three female patients. It is important to note that two of these three implants were not totally firm when placed but were left as a trial. The third patient had previously undergone removal of a subperiosteal implant. During surgery, scar tissue and hydroxyapatite could be found, especially in the left molar region, where later the implant did not osseointegrate and had to be removed during uncovering.

Postoperative radiographs reveal that there is marginal horizontal bone resorption. This resorption had happened already during the incorporation of the fixtures (Figs. 9–11). After uncovering, some bone resorption could be observed (Fig. 12) but usually did not progress during the observation period (Figs. 13 and 14).

DISCUSSION

The method presented herein enables the surgeon to improve the intermaxillary relationship and to restore the original facial dimensions in both the vertical and the sagittal planes. Esthetically, the patient looks younger because of the better bony support of the soft tissues, there are less deep grooves, and the typical concave profile line of the edentulous elder patient is corrected to a more convex profile. Because of the improved intermaxillary relationship and the augmentation in the vertical and horizontal planes, the temporary dentures after the operation fit much better than the previous dentures did. Even if all the implants were lost, the patient would have a better situation for wearing dentures, but the results show that after a median follow-up of 2 years, 8 months, 95.4% of the implants still functioned. It is of course important that the implants are primarily firm, because two of our losses are due to primary loose fixtures.

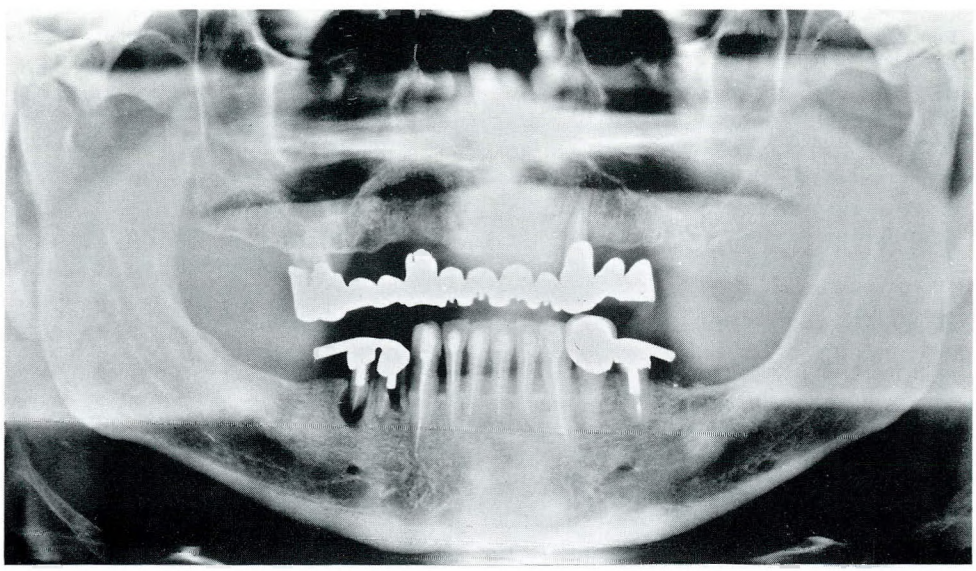


Figure 9. Preoperative panoramic radiograph of a 59-year-old man whose bridgework was supported by two loose teeth. There was not a severe atrophy of the maxillary alveolar process.

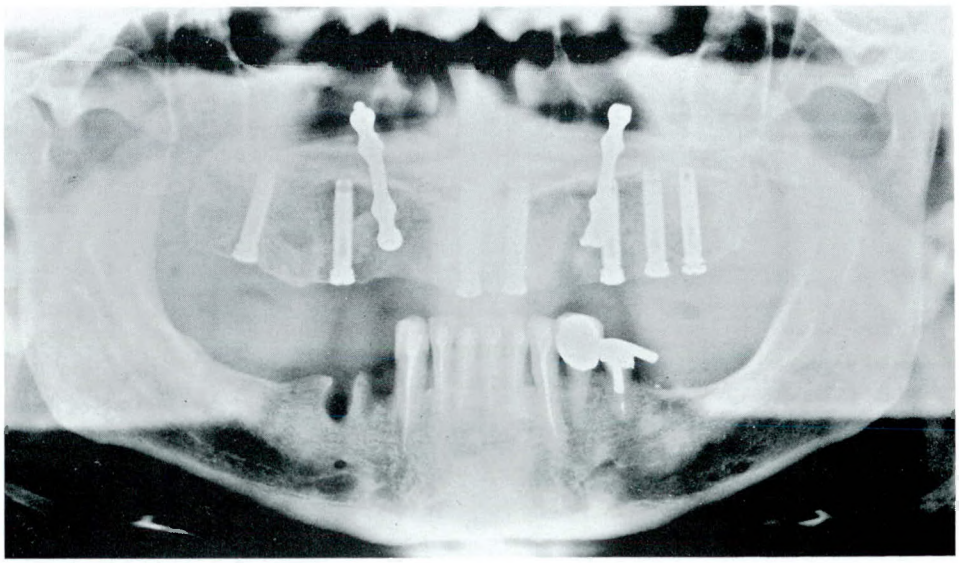


Figure 10. Ten days postoperatively, the radiograph shows that the fixtures are totally inserted into the bone.

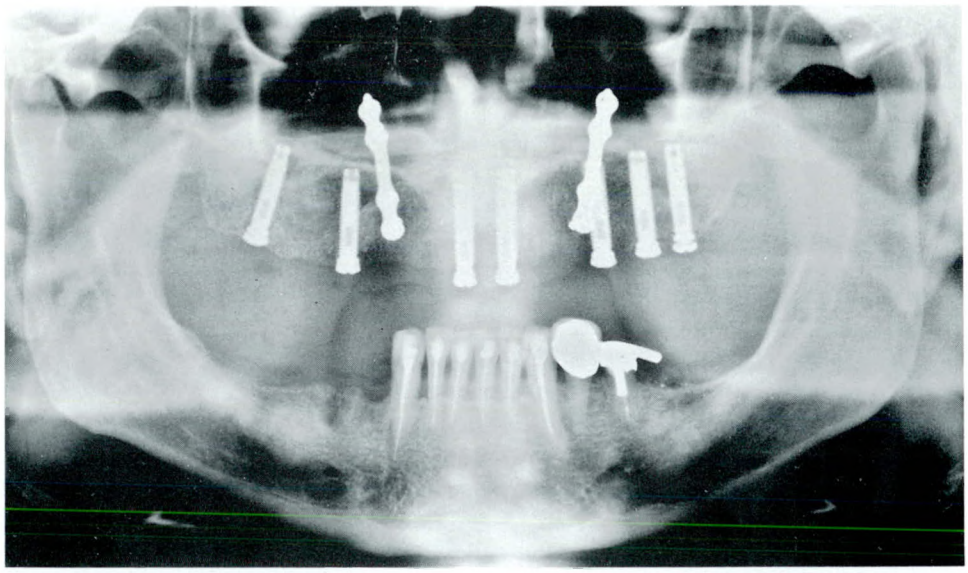


Figure 11. Six months postoperatively, a slight marginal resorption can be observed, showing that some of the cover screws are no longer embedded in the bone.

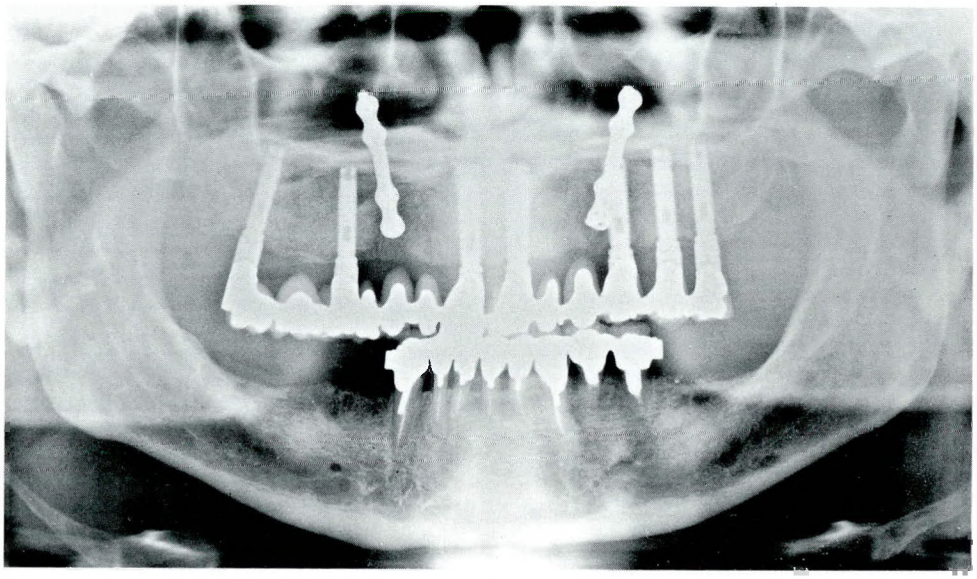


Figure 12. One year after insertion of the fixed bridgework, some of the fixtures show funnel-shaped marginal bone resorption.

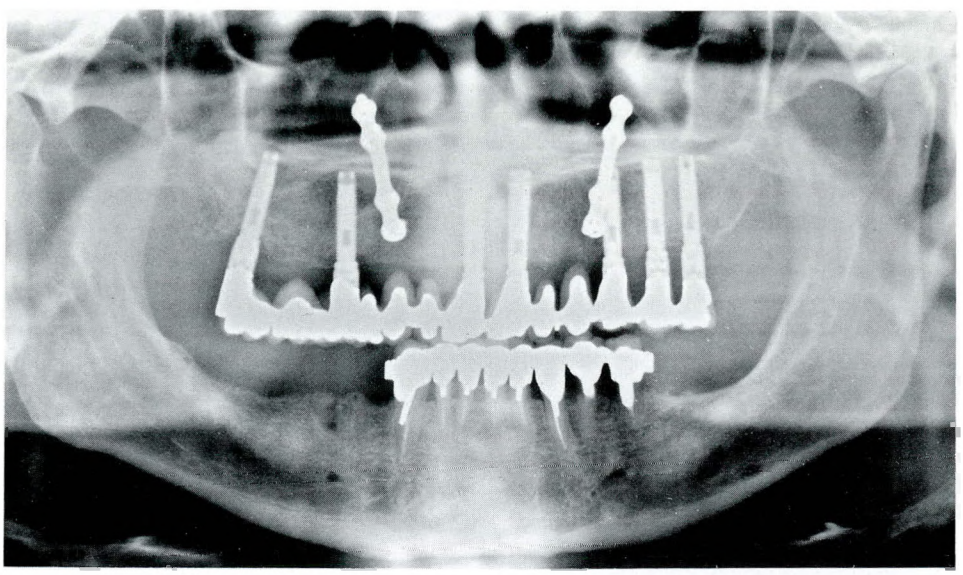


Figure 13. At 2 years, 6 months after insertion of the suprastructure, radiography shows no ongoing resorption.

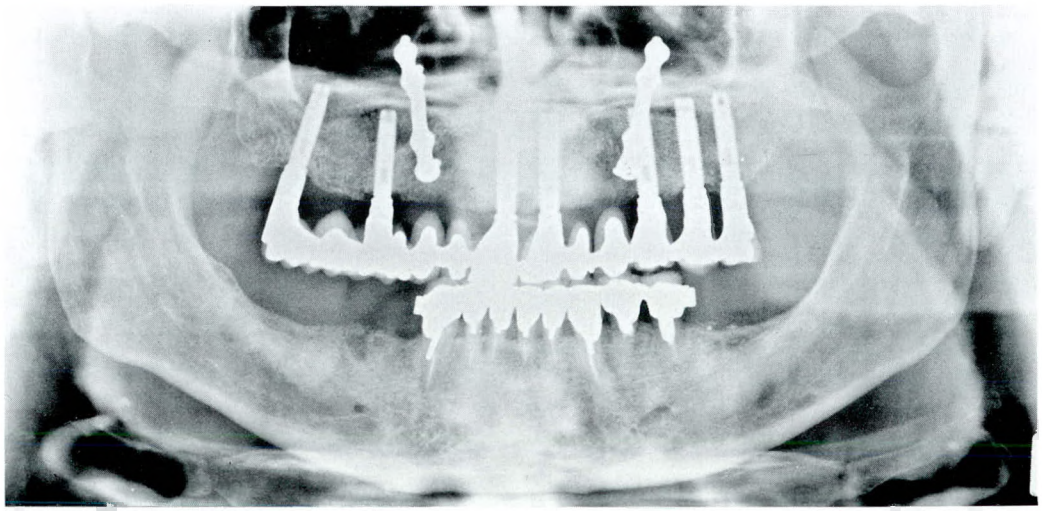


Figure 14. At 3 years, 6 months after insertion of the suprastructure, radiography shows no further osseous change.

Implants should be placed in any case of mandibular dentition, or a resorption of the upper jaw due to the bite forces of the mandibular dentition must be expected. In the literature some authors even use a combination of bone grafts and Brånemark implants to restore the maxilla. Breine and Brånemark[1] used cortical and spongiose bone graft in a type of onlay technique around implants that could be not totally inserted in the original maxillary bone. This technique was used in 18 patients, 14 times in the maxilla. In total, 129 fixtures were inserted, and of them, 74.4% were lost.

Better results were reported by Jensen et al[3] with a sinus lifting and sinus inlay technique with spongiose bone and delayed placement of fixtures. Of 36 implants in five patients after a median follow-up of 16 months, 25% were lost. The procedure of Jensen and Sindet-Petersen[2] consisting of onlay bone grafts after sinus lifting and a nasal lift procedure may be performed only in patients with a correct intermaxillary relationship. The results in nine patients with 61 fixtures showed a loss rate of 8.2% after a median follow-up of 16 months. Because of the nasal lift procedure, respiratory problems might occur in their procedure. In addition, their patients were not allowed to wear dentures for 6 months on the average, whereas our method allows the incorporation of properly fitted conventional dentures 4 weeks postoperatively.

Keller et al,[4] from the Mayo Clinic, described a modified Le Fort I sandwich procedure without opening the maxillary sinus and immediate or delayed placement of implants. This procedure is possible only in patients with sufficient alveolar height. It is therefore not indicated in cases of extreme atrophy. In their nine patients with 49 fixtures, 18.4% of the implants were lost after a median follow-up of 1 to 1.5 years, but 39% of the fixtures were still not uncovered. In 1993 Pelster et al,[5] using our method, reported a loss rate of 30.5% for 59 implants in eight patients. These authors used self-tapping Brånemark fixtures with a length of only 10 to 13 mm. Stoelinga and Cawood[8] reported two patients with a bone necrosis of the anterior part of the maxilla after an operation in another clinic. It is therefore very important to point out that this is not an appropriate procedure for the inexperienced surgeon.

This procedure is an universal method for the treatment of the edentulous maxilla and the only method allowing the placement of implants in extreme cases of maxillary atrophy.

References

1. Breine U, Brånemark PI: Reconstruction of alveolar jaw bone. Scand J Plast Reconstruct Surg 14:23–48, 1980

2. Jensen J, Sindet-Pedersen S: Autogenous mandibular bone grafts and osseointegrated implants of the severely atrophied maxilla: A preliminary report. J Oral Maxillofac Surg 49:1277–1287, 1991
3. Jensen J, Krantz Simonsen E, Sindet-Pedersen S: Reconstruction of the severely resorbed maxilla with bone grafting and osseointegrated implants: A preliminary report. J Oral Maxillofac Surg 48:27–32, 1990
4. Keller EE, Van Roekel NB, Desjardins RP, et al: Prosthetic-surgical reconstruction of the severely resorbed maxilla with iliac bone grafting and tissue-integrated prostheses. International Journal of Oral and Maxillofacial Implants 2:155–165, 1987
5. Pelster C, Frohberg U, Schmitt W, et al: Complications associated with maxillary bone grafting and simultaneous placement of endosseous implants [abstract]. Presented at the 5th International Congress on Preprosthetic Surgery, Vienna, 1993
6. Sailer HF: A new method for setting endosseous implants in cases of totally atrophied maxillae. Proceedings of the Congress of the European Association of Cranio-Maxillofacial Surgery, Athens, 1988
7. Sailer HF: A new method of inserting endosseous implants in totally atrophic maxillae. J Craniomaxillofac Surg 17:299–305, 1989
8. Stoelinga PJW, Cawood JI: The reconstruction of the class IV maxilla: A two-stage technique. Proceedings of the 5th International Congress on Preprosthetic Surgery, Vienna, 1993

Address reprint requests to

Hermann F. Sailer, MD, DDS
Klinik und Poliklinik für Kiefer- und Gesichtschirurgie
Universitätsspital Zürich
Frauenklinikstrasse 10
CH-8091 Zürich, Switzerland